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Effects of Reclaimed Gin-Loss Cotton on Lint Quality and Spinning Performance

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Economic Research Service
Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

PREFACE

In 1964, a cooperative study was made by the U.S. Cotton Ginning Research Laboratory and the Economic Research Service at Stoneville, Miss., to develop a machine that would do an efficient job of reclaiming and cleaning fibrous material ejected from lint cleaners. The experimental machine was 72 percent efficient in fiber reclaiming ability and 84 percent efficient in cleaning ability.

One phase of the 1964 study was continuous blending (during ginning) of reclaimed fiber into the original bale from which it was removed. For 5-pound spinning lots, the blending operation had little effect upon spinning quality except for a slight increase in manufacturing waste. To better evaluate effects of reclaimed gin-loss cotton on lint quality and spinning performance, a larger scale study was needed. Therefore, in 1965, a study was initiated to obtain data for a more comprehensive evaluation. This report presents the results of that evaluation.

This report is one of a group of studies conducted by the Economic Research Service and the Agricultural Research Service, in cooperation with the National Cotton Council, gin machinery manufacturers, ginners, and producers. Results of recent related studies were published in the following reports:

Cotton Fiber and Spinning Properties As Affected by Certain Ginning Practices in San Joaquin Valley, California, Season 1958-59. John E. Ross, Clarence G. Leonard, and Edward H. Shanklin. MRR-486, 1961.

Effects of Cotton Ginning Practices on Market Quality of Cotton, A Mississippi Delta Variety, 1958-59. Edward H. Shanklin, E. W. S. Calkins, and Oliver L. McCaskill. MRR-576, 1963.

Multiple Lint Cleaning at Cotton Gins: Effects on Bale Value, Fiber Properties, and Spinning Performance. Zolon M. Looney, L. D. LaPlue, Charles A. Wilmot, Walter E. Chapman, Jr., and Franklin E. Newton. MRR-601, 1963.

Effects of Cotton Ginning Practices on Cotton Yarn Properties, Weaving Performance, and Fabric Properties. Edward H. Shanklin and Robert A. Mullikin. MRR-655, 1964.

Fiber and Spinning Properties of Cotton as Affected by Certain Harvesting and Ginning Practices, Yazoo-Mississippi Delta, 1959-60. Franklin E. Newton, E. W. S. Calkins, and Anselm C. Griffin. MRR-656, 1964.

Some Effects of Gin Drying and Cleaning of Cotton on Fiber Length Distribution and Yarn Quality. John E. Ross and Edward H. Shanklin. MRR-666, 1964.

Effects of Defoliation, Harvesting, and Ginning Practices on Micronaire Reading, Fiber Properties, Manufacturing Performance, and Product Quality of El Paso Area Cotton, Season 1960-61. Preston E. LaFerney, Robert A. Mullikin, and Walter E. Chapman. MRR-690, 1965.

Comparative Performance of Saw and Roller Gins on Acala and Pima Cottons. W. E. Chapman, Jr., and V. L. Stedronsky (Participated in by Pilot Spinning Plant). MRR-695, 1965.

Moisture Restoration to Cotton at the Gin: Effects on Fiber and Spinning Properties. Gino J. Mangialardi, Jr., A. Clyde Griffin, and Edward H. Shanklin. MRR-708, 1965.

Drying and Cleaning Cotton at the Gin: Effect on Fiber Properties and Spinning Performance, San Joaquin Valley, 1959-60. V. L. Stedronsky, John E. Ross, and Edward H. Shanklin. MRR-710,1965.

Comparative Effects of Mechanical Picking Spindles and Handpicking on Cotton Quality and Spinning Performance in Mississippi, 1960-63. E. Buford Williamson, Charles S. Shaw, Zolon M. Looney, and Edward H. Shanklin. MRR-730, 1965.

Comparative Effects of an Experimental and a Conventional Seed Cotton Drying System on Cotton Fiber Properties. Edward H. Shanklin, Konrad Semrau, and Preston E. LaFerney. MRR-733, 1966.

Spinning Quality of Cotton as Affected by Gin Cleaning, Card Crusher Rolls, and Varying Carding Rates, Mississippi, 1965-66 Season. Preston E. LaFerney, Robert A. Mullikin, and Charles S. Shaw. MRR-778, 1966.

Evaluation of the Fibrosampler and the Digital Fibrograph for Sampling Cotton Fibers and Measuring Length Characteristics. Frances Carpenter. MRR-775, 1967.

Effects of Certain Drying Treatments in Ginning on Fiber Properties and Spinning Performance of Southeastern Cotton, Crop of 1960. Warren E. Garner and Robert A. Mullikin. PRR-85, 1964.

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SUMMARY AND CONCLUSIONS

Current testing methods and apparatus could not detect any adverse effect on lint quality from blending approximately 11 pounds of reclaimed gin-loss cotton into a bale. The only manufacturing or spinning properties showing any statistically significant difference that might be attributed to blending of gin-loss cotton into a bale were manufacturing waste and neps per 1,000 yards of yarn. Manufacturing waste increased by a total of 0.61 percent, or 3.1 pounds per 500-pound bale. However, even after allowances for waste loss, about 7.6 pounds of material were utilized by the spinning process. Any adverse effect that blending might have on yarn neppiness could affect the price of yarns and fabric goods manufactured from such yarns.

Though test results indicate few adverse effects on lint quality and spinning performance as a result of blending reclaimed fiber into a bale, we do not suggest that it would be feasible as a commercial practice. Many problems which this test was not designed to answer could more than offset any economic gains. Some of the more apparent problems are as follows:

(1) Effect of the practice on cotton's competitive position with other fibers, both domestically and abroad.

(2) Effects not detected in fiber quality and spinning performance which might occur at dyeing and finishing stages of manufacturing.

(3) Discounts which mills would make to offset increased manufacturing waste.

Assuming that the practice could surmount these and other problems, it would be possible to develop a full-scale model of the reclaiming and cleaning machine which would be attached immediately behind the last stage of lint cleaning. This machine would perform essentially the same function as reclaiming devices on extractor feeders, bur machines, stick and green leaf machines, and other gin equipment.

EFFECTS OF RECLAIMED GIN-LOSS COTTON ON LINT QUALITY AND SPINNING PERFORMANCE

by

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INTRODUCTION

A study made in 1963 showed that a better method of removing trash at the gin was needed to improve the quality and marketability of gin motes. 1/ Dealers said that they had ready markets for this type of cotton waste, except when it contained abnormal quantities of trash. In 1964, the U.S. Cotton Ginning Research Laboratory and the Economic Research Service at Stoneville, Miss. began a cooperative study to develop and evaluate a machine that would reclaim and clean gin motes. 2/ The machine proved highly efficient, reclaiming an average of 72 percent of the fibers and removing an average of 84 percent of all foreign matter in a single pass.

The term gin-loss cotton, or reclaimed fiber, as used in this report, is not the same quality of product that the cotton waste and linters trade refers to as gin motes. As currently marketed, gin motes are essentially lint cleaner waste from which little or none of the foreign matter has been removed. In contrast, gin-loss cotton is the fibrous material of lint cleaner waste from which over three-fourths of the motes and foreign matter has been removed by a reclaiming and cleaning device.

Because of the cleanness and staple quality of reclaimed gin-loss cotton, another objective of the 1964 study was to determine the feasibility of blending these fibers into the original bale from which they were removed. The fibers were blended into the bale throughout ginning. Spinning tests were made to see what effect blending these fibers into the bale had on spinning performance. Test results showed an increase in picker and card waste, but little adverse effect on spinning quality. However, these initial tests were based on 5-pound spinning lots.

1/ Holder, Shelby H., Jr. and Looney, Zolon M. Reclaiming and Marketing Cotton Gin Motes. U.S. Dept. Agr., Econ. Res. Serv., ERS-168. 1964.

2/ Watson, Harold and Holder, Shelby H., Jr. Reclaiming Gin-Loss Cotton. U.S. Dept. Agr., Prod. Res. Rpt. 91. 1966.

To better evaluate effects of reclaimed gin-loss cotton on lint quality and spinning performance, larger scale spinning tests were needed. Therefore, in 1965, a study was initiated to provide data for more comprehensive evaluation. This study was planned and executed in cooperation with the USDA Pilot Spinning Plant, Clemson, S. C.

Fiber array tests from the 1964 study showed that about 80 percent of the fibers in reclaimed gin-loss cotton were longer than one-half inch. 3/ Approximately 47 percent of the reclaimed fibers were longer than 1 inch, compared with about 62 percent for ginned lint from the same bale. Upper quartile length and mean length for the reclaimed fibers averaged 1.17 inches and 0.89 inch. respectively. Ginned lint from the same bale had an average upper quartile length of 1.22 inches and a mean length of 1.01 inches.

TEST PROCEDURE

Machine Used

The experimental machine used in these studies was a commercial saw-type lint cleaner in which the combing ratio and saw were modified (fig. 1). The saw cylinder was covered with textile-type doffer wire having 14 teeth per inch of length. The wire was groove-wound onto a cylinder surface at a rate of 10 turns per inch, which provided a tooth density of 140 teeth per square inch of cylinder area. The combing ratio, which is the ratio of surface speed of the saw cylinder to the speed at which the bat of fibers is fed onto the cylinder, was 105 to 1 for these tests.

Harvesting and Ginning Method

The test was composed of 12 bales of machine-picked cotton of one variety from the Mississippi Branch Experiment Station at Stoneville. The seed cotton was picked at midseason from one field so that weathering and soil differences would be minimized. A picker basket containing enough seed cotton for approximately 350 pounds of ginned lint, was dumped on each end of a trailer. Seed cotton from six trailers was ginned at random with a nonblended and a blended lot being ginned alternately from each end of a trailer.

Waste material from two stages of lint cleaning was conveyed pneumatically to the condenser of the experimental reclaimer machine. Fibrous material reclaimed from the nonblended bales was collected for weighing and further testing, and that from blended bales was continuously fed into the lint during ginning. Blending added approximately 8 pounds of reclaimed fiber to a 350-pound lot, or about 11 pounds per 500-pound bale (a little over 2 percent of the bale weight). This reclaimed fiber was fed into the lint stream immediately after the final stage of lint cleaning. The six nonblended lots were ginned without addition of reclaimed fiber.

The ginning machinery sequence was the same for all test bales. It consisted of an automatic seed cotton feed control; 24-shelf tower dryer; 6-cylinder seed cotton cleaner; stick and green leaf machine; 24-shelf tower

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3/ Watson and Holder, footnote 2.

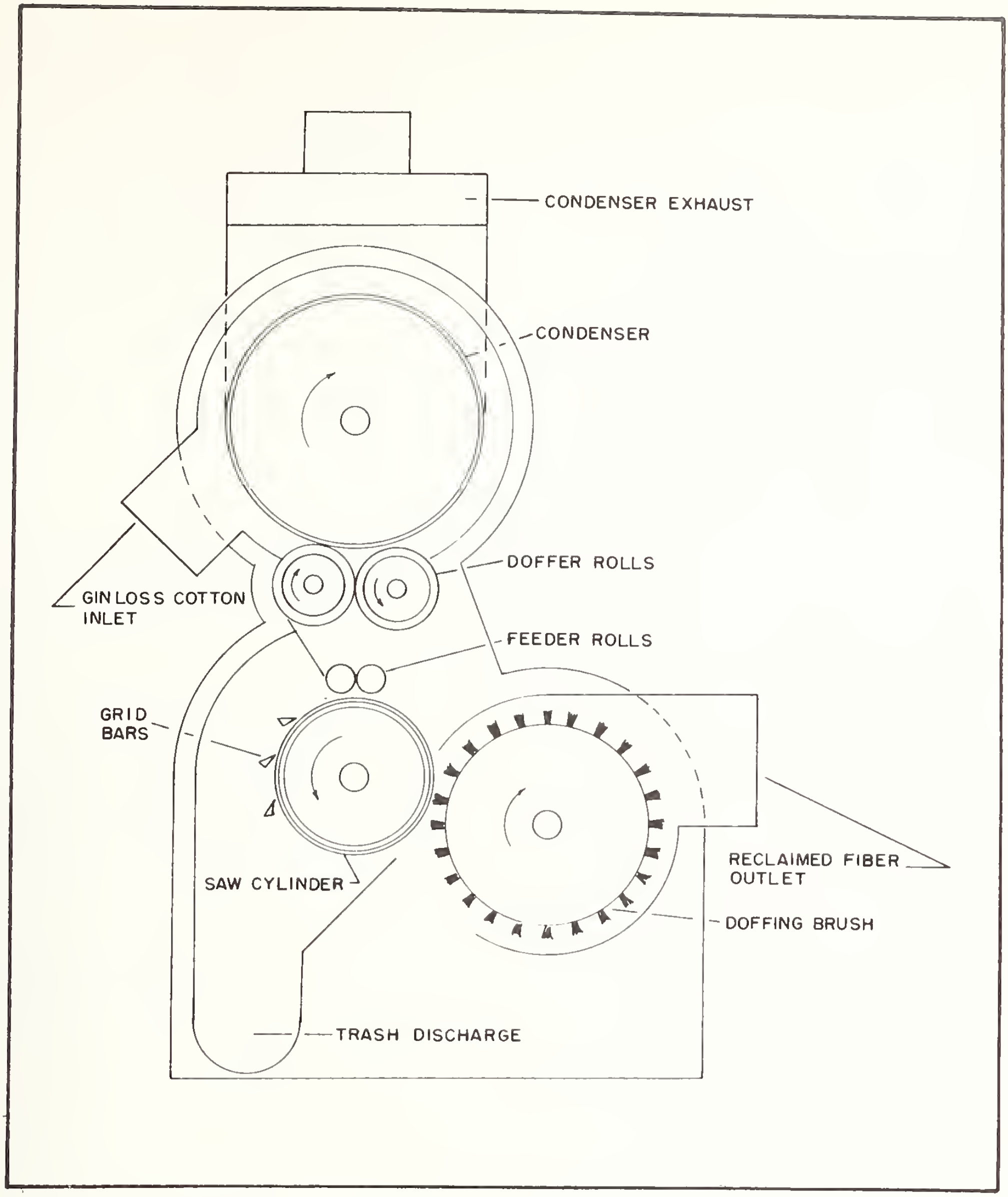

Figure 1.--End view of experimental reclaimer showing major functional parts.

dryer; 7-cylinder seed cotton cleaner; extractor feeder; high-capacity gin stand; two saw-type lint cleaners in series; and bale press. Dryer temperature was adjusted to maintain, as nearly as possible, a constant lint moisture content. Ginning rate was the same throughout the test.

FIBER AND SPINNING TEST RESULTS

All lots were processed individually according to the processing organization given in appendix table 4. They were spun into 40's yarns with a twist multiplier of 3.71 and a spindle speed of 12,000 r.p.m. Fiber and spinning tests were made by the USDA Pilot Spinning Plant at Clemson.

Seed Cotton Quality

Moisture and trash content of the seed cotton for nonblended and blended lots were highly similar (appendix table 3). Although trash content of blended lots was significantly higher, the difference was not statistically significant when the seed cotton reached the feeder apron above the gin stand.

Lint Quality

No significant differences in lint quality were detected between nonblended and blended lots for most fiber properties tested (table 1). This may be due at least partially to the inability of fiber testing instruments and procedures to detect differences in some fiber qualities when a small quantity of fiber is blended into a large mass of fiber.

Blending reclaimed fibers into the bale did not affect the classer's call for grade and staple. This is supported by differences in color of lint and Shirley Analyzer waste which were not statistically significant for blended and nonblended lots. However, Shirley Analyzer tests did detect slightly more waste in blended lots.

Fiber arrays for reclaimed gin-loss cotton and for ginned lint showed that the overall length of gin-loss cotton was shorter than ginned lint from the same bale. 4/ Array test results for this study were not consistent with this relationship, blended lots showed less short fiber than nonblended lots. Even though reclaimed fiber was blended into a bale continuously during ginning, its small proportional share of the total mass would make it particularly difficult to obtain representative fiber arrays.

The significant difference in micronaire readings was probably due to inherent variability of cotton fibers. Since both lots had average fineness, the slight difference is probably not of practical importance.

Spinning Results

Nonblended and blended lots differed significantly in percent of waste removed by opening and picking, and carding processes. Blended lots averaged 0.61 percent more total waste than nonblended lots (table 2). This means that a blended 500-pound bale had 3.1 pounds more waste than a nonblended bale. However, according to the test results, an average of 10.7 pounds of reclaimed fiber was added per 500 pounds for blended lots. Thus, assuming that the 3.1-pound increase in opener, picker, and card waste was due to blending, 7.6 pounds of blended material was added in the spinning process without significant change in most spinning properties.

4/ Watson and Holder, footnote 2.

Table 1.--Fiber properties of raw cotton from nonblended and blended lots, 1967

Property	Unit	Range				Average		Significance level 1/
		Nonblended		Blended		Non-blended	Blended	
		Low	High	Low	High			
Classification:								
Grade	Index	92.3	94.0	92.7	94.0	93.6	93.6	N.S.
Staple	1/32 in.	35.0	35.0	35.0	35.0	35.0	35.0	N.S.
Color of lint:								
Ginned lint								
Reflectance (Rd)	Percent	71.2	74.5	70.0	73.5	72.8	72.4	N.S.
Yellowness	+b factor	9.0	9.6	8.9	9.3	9.6	9.1	N.S.
Cleaned lint 2/								
Reflectance (Rd)	Percent	73.5	75.3	72.0	75.2	74.4	74.2	N.S.
Yellowness	+b factor	9.1	9.6	9.4	9.2	9.7	9.4	N.S.
Fiber length:								
U.Q. length	Inches	1.24	1.27	1.25	1.27	1.26	1.26	N.S.
Mean length	Inches	1.00	1.04	1.01	1.08	1.02	1.03	N.S.
Coef. of length variability	Percent	31	33	30	32	32	31	**
Fibers shorter than 1/2 in.	Percent	8.6	10.1	8.0	9.6	9.5	8.7	*
Fibers 1/2 inch to 1 inch	Percent	25.0	28.6	25.1	28.8	26.9	27.0	N.S.
Fibers 1 inch and longer	Percent	61.6	66.6	61.6	66.9	63.6	64.3	N.S.
2.5% span length	Inches	1.12	1.13	1.11	1.13	1.12	1.12	N.S.
50% span length	Inches	.45	.49	.43	.50	.47	.47	N.S.
Uniformity ratio	Percent	40.0	44.0	39.0	44.0	42.0	41.7	N.S.
Fiber strength:								
"0" gage	1,000 p.s.i.	78	80	77	80	79	79	N.S.
Fiber fineness:								
Micronaire	Reading	4.1	4.8	4.2	4.8	4.4	4.5	*
Waste:								
Shirley Analyzer	Percent	2.4	4.0	2.5	4.6	3.0	3.4	N.S.

1/ N.S. - not statistically significant at the 5% level; * - significant at the 5% level: ** - significant at the 1% level.

2/ Ginned lint which has been passed through a Shirley Analyzer to extract the foreign matter.

Table 2.--Spinning properties of cotton from nonblended and blended lots, 1967

Property	Unit	Range				Average		Significance level 1/
		Nonblended		Blended		Non-blended	Blended	
		Low	High	Low	High			
Waste:								
Opening and picking	Percent	0.63	0.81	0.71	1.26	0.70	1.00	*
Card Waste	Percent	3.31	3.58	3.45	3.96	3.47	3.79	**
Total picker and card	Percent	3.89	4.33	4.14	5.16	4.14	4.75	**
Neps per 100 sq. inches	Number	7	13	8	13	11	11	N.S.
Yarn size (obtained)	Number	39.2	39.7	39.1	40.4	39.4	39.6	N.S.
Break factor	Unit	1815	1952	1787	1944	1866	1857	N.S.
Yarn appearance	Index	91	97	91	99	94	94	N.S.
EDMSH 2/	Number	22	37	19	42	28	29	N.S.
Single strand data:								
Strength	Gram	186	197	182	196	191	188	N.S.
Elongation	Percent	5.7	6.2	5.6	6.2	6.0	5.9	N.S.
Strength C.V.	Percent	11.1	11.8	11.2	12.2	11.4	11.5	N.S.
Neps per 1,000 yards	Number	283	373	300	390	329	346	*
Thick places per 1,000 yds.	Number	1058	1200	1055	1206	1140	1128	N.S.
Low places per 1,000 yds.	Number	212	283	200	268	245	232	*
Irregularity C.V.	Percent	20.8	22.8	21.9	22.8	22.0	22.4	N.S.

1/ N.S. - not significant at the 5% level; * - significant at the 5% level; ** - significant at the 1% level.

2/ EDMSH: ends down per 1,000 spindle hours.

Once past the carding process, there were few practical differences in the spinning properties of nonblended and blended lots. Blended lots had significantly more neps per 1,000 yards of yarn than nonblended lots; however, there was no significant difference in neps per 100 square inches of card web. Although there were differences in number of thick places and low places per 1,000 yards of yarn, there was no significant difference in irregularity coefficient of variation.

Table 3.--Condition of seed cotton for nonblended and blended lots 1/, 1967

Lot number	Moisture			Fractionation	
	Trailer sample	Feeder sample	Lint sample	Trailer sample	Feeder sample
	-Percent-				
Nonblended:					
210........	14.58	11.63	5.70	5.25	2.02
212.	12.60	9.77	4.90	5.23	1.53
214........	13.08	9.77	4.83	4.85	1.30
216........	11.80	12.55	4.68	4.42	1.90
218........	18.27	15.10	4.73	3.93	1.98
220........	18.43	13.88	5.10	4.12	1.98
Average..	14.79	12.12	4.99	4.63	1.78
Blended:					
211........	16.47	12.08	5.53	5.83	1.72
213........	13.48	8.62	4.60	4.83	1.70
215........	13.73	11.70	4.52	5.98	1.55
217........	14.80	13.58	4.63	5.20	1.90
219........	18.60	14.82	5.23	5.07	2.08
221........	18.42	14.08	5.00	5.27	1.85
Average..	15.92	12.48	4.92	5.36	1.80

1/ Each sample is an average of 6 subsamples.

Table 4.--Processing organization of spinning test lots, 1967

Process	Specification
Opening and picking..................	14-ounce laps
Carding with crusher rolls...........	9-1/2 lbs./hr., 50-grain sliver
Two-process drawing:	
Breaker (8 ends up)...............	53-grain sliver
Finisher (8 ends up)..............	55-grain sliver
Roving:	
Hanks.............................	1.25
Twist multiplier..................	1.30
Spinning (single creel):	
Yarn size.........................	40's
Twist multiplier..................	3.71
Spindle speed (r.p.m.)............	12,000

Glossary

Break factor.--Product of average yarn skein breaking strength in pounds times yarn number.

Card waste.--The carding machine removes additional trash and short fibers known collectively as card waste.

Coefficient of length variability.--A relative measure of variability in length of fibers in a sample. Large values indicate irregular fiber length and small values indicate uniform fiber length. Excessive variation tends to increase manufacturing waste, make processing more difficult, and lower quality of the product.

Doffer rolls.--Rolls that doff, or strip, the ginned lint from the condenser drum.

EDMSH (ends down per 1,000 spindle hours).--Number of yarn breakages occuring per 1,000 spindle hours.

Fiber elongation.--Increase in fiber length, expressed as a percentage of the original length, of a specimen during a tensile test.

Fiber strength ("0" gage).--Fiber tensile strength of a sample of cotton usually expressed in 1,000 pounds per square inch. Used to determine strength of yarns produced from different cottons.

High and low places per 1,000 yards of yarn.--A numerical count of yarn imperfections by an electrical device that detects and records high and low places in a strand of yarn as the yarn passes between two sensing plates or through a sensing head.

Irregularity C.V..--A relative measure of irregularities (high and low places) in a strand of yarn.

Mean Length.--Average length of all fibers in a sample, based on a weight-length distribution.

Micronaire fineness.--A relative measure of fineness and maturity in combination. The higher the micronaire reading, the coarser the fiber.

Neps per 100 square inches.--Number of neps (small knots or tangles of fibers seen in the card web) occuring per 100 square inches of card web.

Opener and picker waste.--Opener and picker processes at a cotton mill blend, fluff, and clean the raw cotton, and the picker forms it into a picker lap. Trash and fiber removed by these processes is called opener and picker waste.

Strength C.V. (coefficient of variability).--A relative measure of variability in strength.

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Uniformity ratio.--A ration (50/2.5 x 100) of the 50% span length and 2.5% span length. The higher the ratio, the more uniform the fiber length.

U.Q. (Upper Quartile) length.--Length exceeded by 25 percent of the fibers in a sample, based on a weight-length distribution.

Waste (Shirley Analyzer).--Nonlint, or foreign matter content, of a sample of raw cotton. The value includes both visible (pepper trash, etc.) and invisible (dust) loss. These results are distinguished from total picker and card waste in that practically no fiber is included.

Yarn appearance.--Relative evenness, smoothness, and freedom from foreign materials. Evaluation is made by visual comparison with photographic standards.

Yarn size or number.--Number of hanks (840 yards) of yarn that it takes to weigh 1 pound. Hence, a 40's yarn would require 40 hanks to weigh 1 pound.

2.5% span length.--Length exceeded by 2.5 percent of the fibers in a sample of cotton when they are parallelized and randomly distributed.

50% span length.--Length exceeded by 50 percent of the fibers in a sample of cotton when they are parallelized and randomly distributed.

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